Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
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Office of Engineering and Technology and Wireless Telecommunications Bureau Seek Information on Current Trends in LTE-U and LAA Technology	)	ET Docket No. 15-105

REPLY COMMENTS OF WI-FI ALLIANCE

Wi-Fi Alliance hereby submits these reply comments in the above-referenced proceeding in which the Commission's Office of Engineering and Technology and Wireless Telecommunications Bureau seek information on LTE-Unlicensed ("LTE-U") and Licensed Assisted Access ("LAA") technologies, and the techniques they will implement to share spectrum with existing unlicensed technologies such as Wi-Fi that are widely used by the public.[1/] The record in this proceeding confirms that, *first*, there is widespread recognition of the value of Wi-Fi, and, *second*, that there is insufficient information about how both LTE-U and LAA will co-exist with Wi-Fi and other uses of unlicensed spectrum. In addition to the parties that submitted comments expressing coexistence concerns, the Commission should note that many of Wi-Fi Alliance's over 600 members count on Wi-Fi Alliance to express their views regarding important regulatory matters. The issues that Wi-Fi Alliance and others have raised are widely recognized. LAA and LTE-U proponents attempt to demonstrate how those technologies *may* permit access to unlicensed spectrum by others, but the ability to employ coexistence mechanisms is not sufficient. The Commission must continue to monitor developments to ensure that embedded coexistence mechanisms in LAA and LTE-U technologies *will* permit fair access to spectrum by all technologies – so that Unlicensed LTE does not jeopardize the future of Wi-Fi, crucial to our nation's economy.

[1/] *See Office of Engineering and Technology and Wireless Telecommunications Bureau Seek Information on Current Trends in LTE-U and LAA Technology*, Public Notice, ET Docket No. 15-105, DA 15-516 (rel. May 5, 2015) ("*Public Notice*").

I. THERE IS WIDESPREAD RECOGNITION OF THE VALUE OF WI-FI

On-Ramp to the Internet

There is broad agreement on the record regarding Wi-Fi's tremendous value to consumers, businesses, and the nation's economy. The National Cable and Telecommunications Association ("NCTA"), for instance, explains that "the iPad might never have come to market if Wi-Fi had not existed and consumers were only able to use licensed spectrum to get online wirelessly."[2/] As NCTA also points out, the cable industry has relied on Wi-Fi routers to "untether[] the Internet from the Ethernet cable—a key factor in the explosion of Internet usage by consumers," and has led efforts to deploy carrier-grade Wi-Fi outside of customers' homes.[3/] Similarly, as the Wireless Internet Service Providers Association ("WISPA") explains, wireless Internet service providers ("WISPs") rely on Wi-Fi to provide fixed wireless broadband services to millions residing where wireline broadband service is unavailable.[4/]

Carrier Offload

Even licensed wireless carriers and their representatives who generally urge the Commission not to impede the introduction of LTE-U and LAA, like CTIA—The Wireless Association ("CTIA"), recognize the importance of Wi-Fi to the wireless ecosystem in general and to provide offload capabilities in particular.[5/] In its comments, CTIA stresses the ubiquity of Wi-Fi, noting that "Wi-Fi technologies have been and will continue to be an integral part of consumers' wireless usage."[6] T-Mobile likewise views

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2/ *See* Comments of the National Cable & Telecommunications Association, ET Docket No. 15-105, at 5 (filed June 11, 2015) ("NCTA Comments").

3/ *See id.* at 6.

4/ *See* Comments of the Wireless Internet Service Providers Association, ET Docket No. 15-105, at 3 (filed June 11, 2015) ("WISPA Comments").

5/ *See, e.g.*, Comments of CTIA – The Wireless Association®, ET Docket No. 15-105, at 11 (filed June 11, 2015) ("CTIA Comments"); Comments of T-Mobile USA, Inc., ET Docket No. 15-105, at 4-5 (filed June 11, 2015) ("T-Mobile Comments").

6/ *See* CTIA Comments at 11.

"Wi-Fi as a critical component of its network," and works to ensure that all T-Mobile customers can obtain mobile devices with Wi-Fi calling and texting capabilities.[7/]

Avoiding the Tragedy of the Commons

While Wi-Fi Alliance recognizes that the fundamental nature of Part 15 devices favors little regulatory intervention, the FCC cannot permit the introduction of technology that will create a "tragedy of the commons" and impair the critical national resource that is Wi-Fi.[8/] As one commenter explains, in Garrett Hardin's notable "tragedy of the commons," unrestrained freedom to graze in a common pasture inevitably leads to tragedy. A single herder has a strong personal incentive to maximize his own use of the common pasture, but if too many sheep graze in the pasture, no one will be able to use the pasture at all. Ultimately, "[f]reedom in an unmanaged commons brings ruin to all."[9/] Like a shared pasture, unlicensed spectrum is a common resource available for the benefit of the public, and users of unlicensed spectrum must use that common resource responsibly.[10/] Merely adhering to the Commission's appropriately limited regulation of unlicensed spectrum under Part 15 of the rules may not lead to responsible sharing. Introduction of a new technology must therefore be carefully assessed so that it does not jeopardize Wi-Fi and other unlicensed technologies, even if the technology meets the technical specifications of the FCC's rules.

II. COMMENTS CONFIRM THAT QUESTIONS ABOUT UNLICENSED LTE REMAIN

As an initial matter, many commenting parties have identified,[11/] as did Wi-Fi Alliance,[12/] that two distinct Unlicensed LTE technologies were conflated in the Public Notice: LTE-U, a product of the

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7/ *See* T-Mobile Comments at 4-5. *See also* Comments of Ericsson, ET Docket No. 15-105, at 4 (filed June 11, 2015) (highlighting that "[o]ffloading traffic from mobile devices operating on licensed spectrum onto unlicensed spectrum has become vital").

8/ *See* Comments of Leigh Chinitz, ET Docket No. 15-105, at 3-5 (filed May 13, 2015).

9/ *See id.* at 3 (internal citation omitted).

10/ *See id.* at 5.

11/ *See, e.g.* Comments of Alcatel-Lucent, ET Docket No. 15-105, at 4-5 (filed June 11, 2015) (identifying the "two solutions that are being pursued for LTE deployment in unlicensed spectrum" as LTE-U and LAA); Comments

LTE-U Forum, and LAA, being developed by 3GPP. Each technology should be considered individually by the Commission because they may utilize different sharing mechanisms and therefore merit different regulatory approaches.[13/]

LTE Coexistence and Coordination

With regard to LTE-U, many commenting parties question whether the coexistence mechanisms outlined by the LTE-U Forum will adequately protect Wi-Fi or will favor licensed technologies. While LTE-U proponents have identified how coexistence could be implemented, commenting parties question whether those mechanisms could be exploited to favor access to unlicensed spectrum by LTE-U users to the detriment of Wi-Fi.[14/] For example, Cablevision Systems Corporation ("Cablevision") explains that "[c]hannel selection and opportunistic deactivation [two co-existence mechanisms] do not address coexistence between LTE-U and other unlicensed technologies in the most important sharing scenario—

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of AT&T, ET Docket No. 15-105, at 4 (filed June 11, 2015) (differentiating between the "two different versions of LTE unlicensed in development," LTE-U and LAA); Comments of Competitive Carriers Association, ET Docket No. 15-105, at 3-4 (filed June 11, 2015) (describing LTE-U and LAA as two different types of unlicensed LTE technologies); CTIA Comments at 8 (noting differences and similarities between LTE-U and LAA technologies); Comments of Google Inc., ET Docket No. 15-105, at 4 (filed June 11, 2015) ("Google Comments") (distinguishing LTE-U and LAA as "two well-understood efforts to develop technical specifications for use of LTE in unlicensed spectrum"); Letter from Paul Nikolich, IEEE 802 LAN/MAN Standards Committee Chairman, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-105, at 1 (filed June 8, 2015) ("IEEE 802 LMSC Comments") (explaining that "LTE-U is a proprietary solution," whereas 3GPP is developing LAA); Comments of Nokia Networks (d/b/a Nokia Solutions and Networks US LLC), ET Docket No. 15-105, at 5 (filed June 11, 2015) (noting that the "[t]wo variations of LTE in unlicensed spectrum . . . under development by the wireless industry" are LTE-U and LAA).

12/ *See* Comments of Wi-Fi Alliance, ET Docket No. 15-105, at 4-5 (filed June 11, 2015) ("Wi-Fi Alliance Comments").

13/ *See* IEEE 802 LMSC Comments at 1-2 (noting that LTE-U "implements a duty cycle approach to medium sharing," whereas 3GPP still must agree on LAA's sharing mechanisms); NCTA Comments at 7-13 (describing LTE-U's and LAA's different approaches to sharing unlicensed spectrum).

14/ *See, e.g.*, Comments of Cablevision Systems Corporation, ET Docket No. 15-105, at 15-17 (filed June 11, 2015) ("Cablevision Comments"); NCTA Comments at 10-13. *See also* Letter from Christopher Szymanski, Director, Global Regulatory Affairs, Broadcom Corporation, to Ms. Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-105, at 3 (filed June 10, 2015) ("Broadcom Comments") ("[A] common thread for LTE-U is that coexistence mechanisms appear to rely more on assessing the unlicensed spectrum, and forcing other technologies, such as Wi-Fi, to use their politeness protocols . . . to transmit during LTE-U idle periods. In this way, LTE-U appears to control or manage the medium.").

when the two services are actually operating co-channel—and therefore will do little to protect consumers from service degradation."[15/]

As for the third co-existence mechanism, duty cycling, Cablevision acknowledges that it "could theoretically serve as a rudimentary spectrum sharing feature"; however, other unlicensed technologies dynamically accommodate different users, whereas LTE-U's duty cycling switches the LTE-U cell on or off for longer time periods and without regard to the effects on other users of the spectrum.[16/] In fact, Cablevision notes, LTE-U's duty cycling allows LTE-U operators to assert more control over the spectrum by allowing them to dictate when other devices may use the spectrum.[17/] Ruckus Wireless, Inc. ("Ruckus") agrees that LTE-U's duty cycle approach would block networks that employ listen-before-talk ("LBT") for a period of time, which could have a devastating effect on Wi-Fi networks.[18/] Likewise, the IEEE 802 LAN/MAN Standards Committee, which develops the Wi-Fi family of standards, agrees that LTE-U's duty cycle approach does not constitute an appropriate sharing mechanism to ensure coexistence with Wi-Fi.[19/] NCTA further explains that a duty cycle approach would cause Wi-Fi devices

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15/ *See* Cablevision Comments at 15. *See also* NCTA Comments at 10-11 (explaining how "selecting the 'least interfering channel' to LTE-U" will do nothing to prevent interference to Wi-Fi – particularly "in situations where it matters most" – because, "in densely populated areas, typically every available channel is used heavily by multiple Wi-Fi networks").

16/ *See* Cablevision Comments at 15-16. *See also* Google Comments at 5-6 (explaining that, because of how LTE-U's duty cycling works, "the start of an LTE-U transmission commonly interrupts a Wi-Fi transmission in mid-frame and causes that frame to be received in error. As the frame error rate increases, a Wi-Fi device generally responds by reducing its transmission rate and, therefore, its throughput. . . [W]hen an LTE-U device operates on a 50% duty cycle, Wi-Fi speeds are slowed to one-quarter of their interference-free rate.").

17/ *See* Cablevision Comments at 16. *See also* Letter from H. Nwana, Executive Director, Dynamic Spectrum Alliance, to Ms. Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-105, at 3-4 (filed June 11, 2015) ("Unlicensed technologies such as Wi-Fi will be at the mercy of LTE-U operators, whose incentive is to choose a duty cycle that maximizes LTE-U's time on air at the direct expense of Wi-Fi and other unlicensed technologies.").

18/ *See* Letter from Steve Martin, Senior Vice President/GM Emerging Technologies, Ruckus Wireless, Inc., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-105, at 1 (filed June 11, 2015) ("Ruckus Comments"). *See also* Broadcom Comments at 4-5 (suggesting that LTE-U's "coexistence mechanisms" would force other technologies, like Wi-Fi, to use LBT to transmit during LTE-U idle periods).

19/ *See* IEEE 802 LMSC Comments at 1.

to conclude that there is significantly more traffic in the band than there actually is.[20/] These LTE-U mechanisms are essentially "'coexistence features' in name only."[21/]

In any case, LTE-U proponents' claims cannot be verified because of the closed nature of the LTE-U Forum process and the fact that the coexistence mechanisms are proprietary to LTE-U Forum members. As Ruckus explains, because key portions of the LTE-U specification remain proprietary, only implementing vendors can perform tests or analyses showing the impact LTE-U's on existing spectrum ecosystems.[22/]

Immediately before the comment deadline in this proceeding, Qualcomm announced a version of Unlicensed LTE technology that will operate without licensed spectrum (*i.e.*, "MuLTEfire"). [23/] This represents a use case that was not contemplated in the Public Notice and about which even less is known. The Commission may wish to separately seek further information about this technology to determine if it is subject to the same criticisms as LTE-U generally and in any case ensure that it is subject to the same multi-stakeholder process as other Unlicensed LTE technologies.

Industry collaboration remains the most effective means to ensure that coexistence mechanisms are fairly developed and implemented, and Wi-Fi Alliance continues to work towards such goals. Ideally, as Broadcom notes, closer collaboration among 3GPP, IEEE, and Wi-Fi Alliance will lead to interoperability testing and certification to ensure that deployed devices coexist fairly.[24/] Microsoft maintains that the FCC should encourage groups to work cooperatively on fair coexistence mechanisms,

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20/ *See* NCTA Comments at 19.

21/ *See* Cablevision Comments at 15.

22/ *See* Ruckus Comments at 3. *See also* Broadcom Comments at 2 (explaining that LTE-U does not "meet[] the normal criteria of a standard" for several reasons, including that "sharing algorithms are proprietary"); IEEE 802 LMSC Comments at 1 (noting that LTE-U is a "proprietary solution" and not developed by a standards body); NCTA Comments at 11-12 (explaining that LTE-U's "SCell duty cycle" permits LTE-U cells to rapidly switch on and off for an undisclosed period of time – with the precise period marked as "Proprietary" in the LTE-U technical report).

23/ *See* Comments of QUALCOMM Incorporated, ET Docket No. 15-105, at 6 (filed June 11, 2015) ("Qualcomm Comments").

24/ *See* Broadcom Comments at 2-3.

but should also, if necessary, act as a regulatory backstop.[25/] For its part, Wi-Fi Alliance already noted that it has initiated an open-platform simulation initiative and expects industry-wide participation in this effort.[26/] Unfortunately, as the IEEE 802 LAN/MAN Standards Committee makes clear, there in fact has been no collaboration between them (or Wi-Fi Alliance) and any standards body with respect to LTE-U.[27/]

LAA Coexistence and Coordination

With regard to LAA, as others point out, the 3GPP process which will result in standards for LAA is ongoing.[28/] Wi-Fi Alliance reported that there has been no coordination with 3GPP with respect to LAA development, although there have been a number of communication exchanges between those bodies.[29/] It therefore expressed concern "that 3GPP member companies will agree on sharing mechanisms and a definition of "fairness" without requiring agreement from stakeholders outside of 3GPP membership."[30/] This now appears to be a realistic prediction. 3GPP has scheduled a workshop

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25/ *See* Letter from Michael Daum, Technology Policy Strategist, and Paula Boyd, Director, Government and Regulatory Affairs, Microsoft Corporation, to Ms. Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-105, at 2 (filed June 11, 2015) ("Microsoft Comments"). NCTA suggests that the Commission take on a much more active role in developing Unlicensed LTE technologies by coordinating meetings between licensed carriers and the unlicensed community and supervising the establishment of effective sharing mechanisms. *See* NCTA Comments at 36. Wi-Fi Alliance remains hopeful that the FCC need not assume that role; but that industry representatives can address these issues without regulatory intervention. However, Commission involvement must remain an option if collaboration is unsuccessful.

26/ *See* Wi-Fi Alliance Comments at 11-12.

27/ *See* IEEE 802 LMSC Comments at 1.

28/ *See, e.g.*, Comments of the Alliance for Telecommunications Industry Solutions, ET Docket No. 15-105, at 4 (filed June 11, 2015) (asserting that LAA "is being standardized in 3GPP Release 13"); AT&T Comments at 4 ("LTE-License Assisted Access . . . is being worked through the 3GPP standards process . . ."); Google Comments at 4 (noting that LAA is 3GPP's "effort to standardize operation of LTE in unlicensed bands"); Comments of Huawei Technologies, Inc. (USA) and Huawei Technologies Co., Ltd., ET Docket No. 15-105, at 8 (filed June 11, 2015) ("The 3GPP specifications for LAA will be available as part of Release 13 in March 2016."); IEEE 802 LMSC Comments at 1 (explaining that 3GPP members "will agree" on LAA characteristics); NCTA Comments at 6 (explaining that 3GPP is set to finalize 3GPP technology in March 2016); Ruckus Comments at 1 (noting that "3GPP has yet to define [certain] technical aspects of LAA"); T-Mobile Comments at 6-7 ("Adoption of LAA specifications will occur inside the 3GPP consensus-based process. Work has begun on this feature and is expected to be completed approximately in the first quarter of 2016.").

29/ *See* Wi-Fi Alliance Comments at 8.

30/ *See id.*

on August 29, 2015, but only to "exchange views and information" on LAA.[31/] In fact, the workshop is scheduled to occur *after* the week's meetings, suggesting that nothing that occurs in the workshop will immediately inform the work that 3GPP intends to perform on this matter.[32/] 3GPP has not committed to use the information from the workshop to develop appropriate sharing characteristics to ensure coexistence with the Wi-Fi family of standards. To the contrary, it now appears that 3GPP intends to make those determinations without coordinating with IEEE802 or others. 3GPP's workshop does not constitute the "coordination" about which the Commission inquires.[33/]

The Commission should also take into consideration an alternate solution being developed within 3GPP RAN2 (RP-150510, "LTE-WLAN Radio Level Integration and Interworking Enhancement," also known as "LWA").[34/] This Work Item, approved in March 2015 and targeted for 3GPP Release 13, would provide aggregation and tight integration at the radio level allowing for real-time channel and load aware radio resource management across Wi-Fi and LTE, using existing 802.11 technologies and thus assuring compatibility. Technical and eco-system benefits of such a solution should be identified, and considered as part of the overall assessment of LTE and Wi-Fi coexistence. FCC staff should therefore continue to participate in 3GPP meetings to assess whether the standards developed contain adequate and fair mechanisms that would be uniformly deployed.

31/ 3GPP News, *3GPP RAN Workshop on LAA* (June 25, 2015), http://www.3gpp.org/news-events/3gpp-news/1711-laa_worshop.

32/ *See* ETSI Calendar of Meetings, *List of Matching Meetings (3GPP All RAN Future Meeting Calendar)*, http://webapp.etsi.org/MeetingCalendar/ViewMeetings.asp?qTB=373&qINCLUDE_SUB_TB=True&qSTART_DATE=today (last visited June 25, 2015), which lists a number of 3GPP RAN meetings taking place between August 24 and 28 in Beijing, immediately before the LAA workshop also in Beijing.

33/ *See Public Notice* at 2.

34/ *See* 3GPP RAN2, *LTE-WLAN Radio Level Integration and Interworking Enhancement (RP-150510)* (Mar. 9, 2015), *available at* http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_67/Docs/RP-150510.zip.

Optional Coexistence Mechanisms

Recognizing the importance of coexistence, LAA and LTE-U proponents attempt to demonstrate how those technologies *may* permit access to unlicensed spectrum by others. The ability to employ those mechanisms should not be sufficient in the Commission's evaluation, particularly where the decision to use a particular coexistence mechanism and its related parameters remains a choice of individual vendors and network operators. Wi-Fi Alliance remains concerned that operators that do not also manage Wi-Fi networks will have no incentive to use available coexistence mechanisms, thus to the detriment of Wi-Fi operations. Therefore, the Commission must be assured that embedded coexistence mechanisms *will* always provide fair access to spectrum by all technologies – and not just that a technology *may* permit fair access. These coexistence mechanisms must be operational at all times when transmitting in unlicensed bands. Otherwise, the choices of individual operators, not acting maliciously but simply in their own best interests, may threaten Wi-Fi and other unlicensed technologies.

III. CONCLUSIONS

As the record confirms, important questions about Unlicensed LTE technologies remain. It is not yet clear that LTE-U's coexistence mechanisms will adequately protect Wi-Fi or other unlicensed technologies, and the LAA standard remains in development. As the stakeholders develop Unlicensed LTE technologies, the Commission must ensure that those Unlicensed LTE technologies do, in fact, fairly share unlicensed spectrum with Wi-Fi and other current unlicensed uses.

Respectfully submitted,

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